Article

Supporting mathematics learning

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E-LEARNING

In this e-learning issue of the *Bulletin*, three broad topic areas are covered: general developments that will influence current thinking in biological e-learning, experiments that enhance more traditional teaching practices, and articles that help us explore new tools outside bioscience.

Two major elements appear in this issue. One, assessment, is a phenomenon that hits all of us at one time or another, possibly more frequently than we would like, but which guides the direction of the courses we run. The other is the use of e-learning in an integrated, 'blended', learning environment, which, in these days of accessibility, can prove to be both beneficial to the learning community, but also full of traps for the unwary course developer. It is blended learning that I would like to concentrate on.

The experiences of students should be varied and dynamic in any learning environment. Students should feel that they are being included in a lesson in ways that shape its outcomes, rather than being observers asked to participate interactively only occasionally. However, one must ascertain which of the various aspects of a course would be better served, for instance, by e-learning material as opposed to a lecture or practical, or whether a combination of resources is the way forward. From my own experience, I have found that such a combination, with preliminary virtual 'resources' followed by a wet practical, not only makes such aspects run more smoothly, but also inspires students to look 'outside the box', providing them with a wider range of perceptions than had been evident in earlier, non-blended, sessions. I have even integrated onscreen practicals with more traditional practices of writing up and analysis, so it is refreshing to read Alan Bowman and colleagues' article (p.10) on their virtual 'wet lab' experiment. I also read with interest the article on the use of clickers in biology (p.11), and the consequent developments, given that I, presumably along with many others, include quiz items in my lectures to encourage student participation. Giving students an immediate indication as to how they compare with the general class can only be seen as being beneficial!

Of the resource articles, it is the one on social bookmarking that attracted my attention. While I have encouraged the use of virtual bulletin boards and scrapbooks, I have never – until now – thought about getting my students to contribute to a communal online bibliography, which is essentially what Marieke Guy (p.12) is promoting. This is a wonderful idea, as it is an additional tool through which we can enable students to feel included in their (or, rather, our) learning communities and reinforce the idea that everyone can have an effect on the learning process.

Because of my work in Continuing Education, I regularly come across people on my courses with different aspects of what are euphemistically labelled 'disabilities'. I also regularly come into contact with developers keen to adapt their materials to be, and I quote, 'fully accessible to our student population', who then create materials that are biased towards those with visual acuity problems: what Simon Ball (p.7) would, I suspect, describe as a 'lowest common denominator of accessibility'. For years I have argued that accessibility is about getting the right balance, to include everyone – 'able' and so-called 'disabled' alike – including those who are technologically literate or even technophobic. Finally, I have read a paper that points out that something that is made accessible for one group may make it inaccessible to another, and that blended learning has its part to play in all this. I heartily agree with the points he raises, although I would have some contention with describing practicals 'as an alternative fix' to e-learning / multimedia skills! I would also add, 'are those students whom we regard as typical, able people, going to be disadvantaged by what we create?' – a question that seems regularly to be missed.

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FUNDING OPPORTUNITIES

Grants of up to £3,000 and £15,000 available for teaching development. Deadlines early 2007. Further details at *http://www.bioscience.heacademy.ac.uk/opportunities/funding.aspx*

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E-LEARNING SURVEY – PRELIMINARY REPORT

The Centre for Bioscience is currently undertaking a study to discover the current state of, and major issues in, e-learning with respect to the bioscience community. While there was once a time when more or less everything that could be done with Information Technology (IT) in teaching was being covered somewhere by one bioscentist or another, this is no longer the case; technologies have been developed swiftly over the years and the bioscience footprint on these is much smaller. This leaves us with a situation where the legacy e-learning applications fit less well into the current IT environment and the new alternatives offer a bewildering array of choices – virtual learning environments (VLEs), 3rd party online services, publishers online materials, online assessment technologies, open-source projects, e-portfolios, personal learning environments, podcasting etc. Therefore, we have chosen to survey the community on the current application of these technologies with a view to getting behind the scenes of the development process with follow-up case studies, as well as identifying where we can support the effective collaboration of similar projects.

This report is based on the initial stage – the survey of the community about their e-learning use and requirements in July 2006.

INITIAL FINDINGS

The first two questions compared the awareness and actual use of major e-learning tools. The highest responses were resources and course-management tools;

e-learning tool	Aware of	Actually using it
VLEs and MLEs	90% and 49%	68% and 24%
Email	96%	86%
Imagebanks	92%	59%
e-journals & e-books	93% and 89%	68% and 36%

As expected, all those aware (99%) of presentation software e.g. PowerPoint, actually used it in their teaching, most used VLEs or MLEs to manage online materials with email, imagebanks and e-journals & e-books[1] scoring well.

The next highest group appear to be more interactive and content based.

e-learning tool	Aware of	Actually using it
Online discussions	96%	50%
Online assessment	89%	50%
Simulations	87%	26%
Turnitin UK	49%	20%

This would imply institutions' IT infrastructure systems for managing learning are consuming most of the activity in the online learning experience. However, there is still capacity for specialist simulations.

The final, lower band included noticeable new arrivals online.

e-learning tool	Aware of	Actually using it
Blogs & wikis	70% and 49%	7% and 7%
Podcasts	72%	4%
e-Portfolios	52%	11%
Synchronous chat	80%	15%
JORUM	10%	1.5%
ReLOAD	5%	2%
TOIA	5%	0%

New web-technologies, principally blogs and wikis, are gaining a foothold in the short time they have been available but major initiatives from the JISC – JORUM, ReLOAD and TOIA are clearly finding it difficult to engage the bioscience community. It is likely TOIA competes with established assessment systems and JORUM (and consequently ReLOAD) have yet to be signed up in sufficient numbers to be useful (institutional registration is time-consuming).

Podcasts are being noticed and starting to make a minor presence, e-portfolios similarly, and synchronous chat showing a more substantial contribution.

Despite being established technologies video conferencing and web casts are infrequent (4% each) this may be because of limited distance learning opportunities.

MAIN REASONS FOR ADOPTING TECHNOLOGY

Respondents were asked to identify their main reasons for using e-learning (as multiple responses), and highest among these were:

- Flexibility of access 24/7 (80%);
- Ease of modification/update (64%);
- Control of the release of content (55%);
- Better able to meet student needs (54%); and
- Support for large class numbers (44%).

Student demand is still perceived to be reasonably high (61%). However, only few used it primarily to replace an expensive practical (10%) or felt forced into its adoption (20%). The common perception of e-learning being used mostly for saving time is only shared by 42%; supporting comments made by various contacts. Note the time saved is only in the delivery as the preparation is often resource and time expensive. Additional comments included the distance-learning provision and ways of communicating with groups efficiently.

BARRIERS

A clear and outright winner here is the **lack of time** for producing or introducing more e-learning (86%) into the curriculum, followed by a lack of incentive / recognition for staff (52%) to invest effort and resources into e-learning. The frequently changing technical environment disappoints many (28%) with 'lack of skill' being a barrier identified by a similar number (28%).

[1]One must suspect 'e-books' is a misinterpretation – probably online books through library services rather than a downloadable e-book purchased for a local PC or PDA.

Clearly a community working together could make better use of scarce time by successful collaboration and/or the sharing of problems and solutions. The lifetime of resources is limited by technological constraints as well as pedagogically, the former being harder to plan for. More practical examples of successful adoption were requested (20%), more or better training (28%) and more collaborators with a common interest (21%). A lack of confidence, skills, policies and flexibility were raised in the additional comments along with suspicion of the pedagogic guidance received –

"The so-called pedagogical experts can be a barrier if they insist an e-learning activity should be designed and presented their way instead of presenting in a way that students respond the best to."

Successful collaboration depends upon common requirements and interests, with a consistent delivery environment for the final product. Web-based solutions offer this consistency where the browser is the delivery vehicle but the skill set required is likely to deter many unless a supporting network is available. Large-funded projects expect this skill set to be in place but the acquisition of skill needs a flexible approach to support some degree of risk taking to acquire these potentially valuable skills. Our Teaching Development Fund (TDF) is one mechanism for this.

Staff resistance and student unwillingness to engage (25%) appears to warrant further investigation in follow-up discussions in phase II.

SUPPORT

Most staff appear to have access to training (24% very useful, 71% sometimes useful) and these are generally regarded as up-to-date but many staff expect the training itself to identify which topics are currently in vogue. Only 10% felt training was not up-to-date. Further analysis of those showing dissatisfaction here shows most of these use local colleagues, or the Web, for finding further support.

Training courses are always available to 14%, leaving 82% occasional access and 5% no provision at all (staff may be teaching at the same time as the courses themselves are being offered).

The most popular method for getting support to implement e-learning is from a local colleague (75%), followed by local projects (32%) and other institutional colleagues (26%). Subject centres assist 24% with 16% using JISC initiatives. Only 3% required no support at all.

Educational technologists, IT staff local to the department and e-learning champions were often mentioned in the open comments as useful contacts necessary to implement e-learning.

IMPROVEMENTS

Updating the content (54%) and tailoring it to specific needs (44%) are the next types of improvement to existing e-learning needed, along with usability (44%). A minor but noteworthy proportion of respondents would like to upgrade to a web version of existing material (18%) with a similar number wanting to improve the access for the disabled student (20%). There were few (7%) not wanting to make any improvements at all.

'Improving the student learning experience' has so many potential options, not wishing to constrain responses open comment was invited. Within the 80 comments posted, variability, diversity and improved interactivity were cited along with increased adoption of online assessment. Motivation and engagement of the students is desirable but it is recognised in some comments students are "more 'techno-savvy' these days" and have higher expectations of e-learning materials. Such materials require more technically skilled authors and generally more development time to be competitive in the evermore sophisticated e-learning arena.

CONCLUSIONS

Time, time and more time is the community need expressed by most of staff. Unfortunately time constraints are not likely to diminish in an environment of increasing student numbers. Efficient solutions require local collaborators and subject-based communities of practice to be supported in common goals as well as technical solutions which are both modifiable and transferable. Email is not efficient for this type of project work and it is the successes in cross-institutional projects which form a core of shareable e-learning materials. JORUM is yet to establish a foothold and needs significant discipline-based support to bridge the gap. The Internet (outside education) is highly advanced and so if online delivery is used students expect to engage in attractive and focussed materials. Academic interest in the development of e-learning material is still high and the training is generally available but the opportunities to take them are still limited for many.

There are a number of different models of development of e-learning and its evaluation that can be investigated with follow up analysis. A series of case studies is currently on-going across the UK. The aim is to highlight a range of approaches, with their benefits and pitfalls, to assist the bioscience community to develop e-learning materials which can be shared, managed, updated, have components that re-used in many contexts and work as a medium for successful and enjoyable collaboration in the bioscience community.

E-LEARNING REFERENCE GROUP

Of the 151 respondents, 85 (56.3%) were willing to join the e-learning reference group and this should provide the Centre with information from a wide range of subject disciplines, institution types and implementation methods. We are currently considering how best this might be achieved. A simple email list is easy enough to set up but these are not necessarily the most productive for effective dissemination and discussion. We are investigating other technologies based on social networking to do this.

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4 E-ASSESSMENT

Assessment is an influential factor related to how students learn and yet it seems to be the aspect of curriculum design and development that causes teachers the most difficulties. In a period of increasing diversity of the student population online learning and assessment strategies offer many advantages. Some are expressed below:

- Flexibility of access (especially using the Web) in time, place and the selection of assessment options;
- Equitability, taking into consideration diversity, international students – reducing time constraints and allowing more opportunity for students to demonstrate their knowledge and understanding;
- Student-centred learning – open access can encourage students to take responsibility for their own learning;
- Immediacy of feedback for students in well-designed assessments;
- The potential for interactive assessment tasks that are in themselves learning experiences, including online questions that incorporate information-rich images, sound and text;
- Immediacy of marks and outcomes to staff, for monitoring and adaptation.
- The potential to reduce costs and staff workloads through automation of routine assessment tasks; and
- Enhancement of student learning outcomes which can lead to positive attitudes to learning.

(James *et al.*, 2002; Jenkins, 2004; Peat and Franklin, 2002)

Clearly researchers in the field of teaching, learning and assessment believe that online assessment promises much. However, practical issues need to be considered. For example:

- There is a need for institutions to recognise that development time is essential for good e-learning to occur and to properly resource departments and educational development units;
- There are potential risks relating to institutional infrastructure, hardware, software and administrative procedures;
- Both staff and students need to have the appropriate ICT skills and experience to engage in e-learning and online assessment;
- To maintain course integrity, rigorous arrangements must be made to administer online tests or examinations; and
- The potential for plagiarism and other forms of cheating may be increased with online assessment.

Decisions on the scope for e-assessment will depend to a large extent on the institutional infrastructure for e-learning. There is much anecdotal evidence that institutions are keen to develop a curriculum which incorporates e-learning in an appropriate manner but fall back on tradition when it comes to assessing student learning. The most problematic issue is ensuring that those being assessed are who they say they are. It is almost impossible to ascertain a participant's identity when communicating over the Internet. This is not to say the situation is impossible. Most institutions are campus based and do not aspire to be e-institutions – and therefore, there is no reason why students cannot carry out their summative assessment in a properly supervised computer laboratory.

Recognition difficulties aside, some interesting work is being done within the biosciences on e-assessment. A few examples are outlined here. Tony Gardner-Medwin, for example, has added another dimension to MCQs by requiring a confidence judgement from students (Gardner-Medwin, 1995). After each question students are asked to indicate their degree of certainty in their answer (low, medium or high). The marking scheme is simple: 1, 2 or 3 marks for correct answers and 0, -2, -6 marks for wrong answers (depending on the confidence level). Such an approach raises awareness that uncertain but correct answers, or lucky guesses, are not the same as knowledge, and that confident but incorrect answers deserve special attention. In this example technology streamlines question delivery and marking.

Another project – OLAAF (OnLine Assessment And Feedback) uses computer-based assessments, spaced throughout a molecular cell biology module, to 'set the pace' of learning and encourage students to establish an effective study routine (Case Study 6*). For those interested in engaging students in self- and peer-assessment in an online environment, Richard Parsons (University of Dundee) has developed an online system for self and peer assessment of text according to defined criteria. *(http://www.dundee.ac.uk/learning/leu/ilt/selfpeer.htm)*. Crook and Park (2004) used IT in the form of electronic student diaries to investigate the nature and timing of assessments for a range of degree problems and thus further understand the overall assessment experience for students.

The Centre for Bioscience would be interested to hear from anyone using IT to improve student assessment.

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**This article is based on the more extensive coverage of the topic found in chapter 3 of Effective Use of IT: Guidance on Practice in the Biosciences by Lorraine Stefani. ISBN 0-9548751-1-7. Available free of charge from the Centre for Bioscience.*

BLENDED LEARNING

Why blended learning? In a review of the UK literature for the Higher Education Academy, Sharpe *et al.,* (2006) suggest the term blended learning was attributed in the 1980s to the Open University's model of blending distance learning with face to face support. Nowadays the term is rather ill-defined and can mean different things to different people. The British Educational Communications and Technology Agency (BECTa) describe it as a "combination of face-to-face and on-line delivery." Such a blend of e-learning and class-based learning offers some of the best of both worlds, combining the any time/pace/place advantages of online facilities and materials, often through a mix of media, with opportunities for tutor and peer contact and support.

For many tutors the reason for providing blended learning is that it works, enabling them to support learning that focuses on the best learning style for each student. Educational programmes can be tailored to the kinds of useful delivery media that are convenient, user-friendly, and (most importantly) serve the needs of the learner. TechDis argue that using blended learning can offer a great variety of presentation methods and can revisit materials covered previously in class, and these materials can be more easily adapted to learners' needs (for more, see Simon Ball's article on page 7).

Blended learning can improve the quality of the learning experience through:

- Individualised learning experiences for all learners, including those who are disadvantaged, disabled, exceptionally gifted, have special curriculum or learning needs, or who are away from home/work;
- Personalised learning support – information, advice, and guidance services help learners find a suitable course, with seamless transition to the next stage of their learning, which may include online enrolment as well as a portable e-portfolio;
- Collaborative learning – this offers a wide range of online environments to work with, and learn from, other individuals or groups of learners as well as tutors, and develop the cognitive and social skills of communicating and collaborating;
- Virtual learning environments (VLEs) – learners can take part in active and creative learning with others through simulations, role-play, remote control of real-world tools and devices, online master classes, or collaboration with others;
- Flexible study, with learning on demand, anytime or anywhere, to meet learners' needs; and
- Wide access to digital resources, shared tools and information.

GETTING THE BLEND RIGHT

The blended learning mix will offer a variety of teaching and learning styles, course materials and learning technologies such as:

- Traditional classroom/lecture theatre/laboratory environment
- CD-ROM/DVD
- E-mail/SMS
- E-books
- VLEs, including message boards and chat rooms
- asynchronous online delivery/tools, like wikis and blogs
- synchronous online delivery/tools, like instant messaging

The right solution for each programme, and indeed each learner, depends on the balance of learning provided within the blended learning mix. The desired level of learner autonomy must be considered; if you require learners to take responsibility for their own learning: to select how, when and where to learn, they must have the responsibility, skills and motivation to make those decisions.

The design of the blended learning mix needs to be built around the fundamental ways in which people learn. Individuals acquire knowledge and skills through a blend of many different experiences such as reading, observation, collaboration, trial and error, guided practice, application and experimentation. These same learning principles should be built upon in the development of every blended learning programme. A holistic approach has to be taken to the development of blended learning programmes if they are to be successful. The various elements of learning should be viewed together, as one solution. Meaningful connections between teaching, tutoring/mentoring and e-learning content, will lead to a more robust programme which supports and maintains motivation.

Learning programmes that effectively blend multiple learning strategies and styles represent the very best of traditional teaching methods and exemplars for the future. The emphasis on overall programme design and development requires practitioners who understand the pedagogy of learning and who can maximise the potential of the learning technologies that are available to them. If you would like to learn more about blended learning you may wish to review the work of the Blended Learning Unit (BLU) CETL at the University of Hertfordshire *(http://www.herts.ac.uk/blu).*

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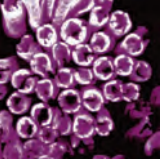

E-LEARNING NEWS

BIOSCIENCE WINNERS

Bioscientists made it a clean sweep at this year's e-Tutor of the Year run by the Times Higher, the Higher Education Academy and the Association for Learning Technology.

E-Tutor of the Year Award

Henry Keil's, winning entry, is a biosciences module that takes students' different learning styles into account.

Recent changes in Higher Education aim to create a market that empowers students to exercise a degree of choice. Universities have to react to these challenges by developing innovative and unique 'products' such as differential fees/bursaries, creative branding, introduction of flexible courses and the development of novel learning tools and teaching methods.

In this module the concept of choice was introduced by offering six different coursework elements, from which students took a minimum of three. The activities were accessed via a WebCT VISTA interface, submission deadlines were set and grades returned at regular intervals to enable students to gradually build up their portfolio. As an extra incentive the final coursework mark was calculated from the 'best three assignments submitted' enabling students to improve their final grade by undertaking an extra activity if they had done poorly in an earlier assignment. Twenty percent took advantage of this, one student took five!

There was an increase in the average coursework mark by 6% (absolute) and a reduction in failed coursework by half compared with previous years. Although generating the extra coursework assignments and building the online learning environment was time consuming, it is a one-off investment. There is more marking as extra assignments come in, but this should be compensated by the reduction in failed coursework and the accompanying lower number of re-sit assignments to be set.

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E-Tool of the Year Award

Electronic portfolios of students' work are increasingly popular with employers. Profile *(http://www.profile.ac.uk)* provides students with a personal and secure electronic portfolio (e-portfolio) and enables academics to track and guide student learning remotely. Profile has been taken up in 22 universities across the UK, and can be used in a wide range of applications such as PDP (personal development and planning), skills and employability audit, and electronic versions of portfolios of professional bodies.

Profile has been used for a number of years to track students' progress when they are on work placements. A range of online forms enable students to record new skills, challenges completed, or areas of new knowledge. The system is very popular with students, who say they feel fully supported by their tutor even though they are on work placement away from the University. The system has a built in communication tool and the advantage for tutors is that it enables them to regularly monitor their students' progress. For employers e-portfolios could be the 'Eldorado' of the future – providing a detailed and securely validated record of achievement. Mitesh Patel, a student who used Profile on his placement said, "Using Profile is great. I prefer using computers to writing on paper and though my placement was in Sweden, I was always in contact with my tutors in the UK where they guided my learning."

Any task that can be managed through forms can be emulated on profile, version 4 of which is due to be launched in the autumn. The benefits of Profile were more fully described in *Bulletin 16*, p2-3.

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CELLS – COLLABORATIVE E-LEARNING IN LIFE SCIENCES

Background

The CeLLs project, funded by the Scottish Funding Council e-learning Transformation Programme, is a collaboration between the Scottish Colleges Biotechnology Consortium, Napier University, The University of Dundee, The Scottish Qualifications Authority (SQA) and The Interactive University Ltd (IU), a not-for-profit commercial company.

Project Aims

The major aim is to create and share core online materials for early-years learning and teaching in Life Sciences. Each academic institution will use the materials to move to a more student-centred approach to learning and a blended approach to teaching. Partners will also develop additional materials that will help contextualize the core, online materials according to the specific learning needs and ethos of each institution (e.g. HNC, HND, degree streams).

Progress

A core curriculum and learning objectives common to all academic partners have been identified in cell & molecular biology, microbiology, immunology, chemistry, biochemistry, metabolism, and genetics. Academic authors are developing and reviewing core learning materials for conversion to e-learning objects by technologists at the IU. The first objects will be released for student use and evaluation during November 2006. On completion of the project (August 2007), the outputs will be made available for use throughout the college and university sector via JORUM.

For further details see *http://www.cellsproject.org/*

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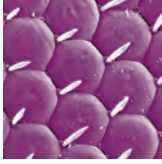

INCLUSIVE E-LEARNING

Accessibility is a balance – an interactive media-rich resource which suits a dyslexic learner, a deaf learner and a learner with cognitive difficulties may be inaccessible to a blind student using a screen-reader (software that reads aloud text on the screen). A text-based resource, accessible to a screen reader user may be inaccessible to the other learners mentioned above. 'Design for all' applies more readily to passive content on web sites than it does to active learning experiences in an educational setting.

Many of the techniques suggested by TechDis and others will improve accessibility for one, but not necessarily all target groups. Thought should be given to who might benefit from different approaches and how the needs of other learners might be accommodated, rather than dismissing certain approaches purely because one or other user group cannot access them. This approach can give lecturers flexibility to adapt resources to many different types of learner needs without needing a high degree of IT skill.

ADVANTAGES OF E-LEARNING

In terms of making learning materials inclusive, e-learning offers many distinct advantages over traditional, paper-based resources. Making documentation available electronically is a major first step in accessibility and inclusivity. Learners should be given the ability to personalise:

- Font type, size, colours and magnification;
- The pace of learning by accessing materials outside the classroom;
- The route through materials using hyperlinks; and
- Access to support materials using hyperlinks.

Micosoft Word features (pop-up comments, drop-down menus, drag and drop, hyperlinks, sound clips etc) can add benefit to a wide range of learners in different ways. Similarly, PowerPoint used creatively can make learning experiences more accessible to many different learners at different levels. For this reason TechDis have produced Accessibility Essentials, free, good practice guides to working with Word and PowerPoint (and, shortly, Adobe PDFs) to enable all staff to use everyday software to the best advantage of all students.

There has been a lot of negative information regarding the accessibility (or rather, the lack of it) of more advanced multimedia. It has even been suggested that certain types of media (for example, video, Flash or podcasting) should not be used, precisely because they are not accessible to all students. On the contrary, TechDis believes that multimedia is assistive technology. Its usage broadens the range of learning experiences, and will engage some students in ways that other techniques will not. Our recommendation is to not avoid the use of multimedia or animation, as it adds considerably to the learning experiences of many. Where you have the skills, make multimedia as accessible as possible (e.g. add subtitles or transcripts). Where you haven't got those skills, develop alternative fixes (e.g. plasticine models, practicals, one-to-one explanations). This will ensure that all students get benefit from the increased variety of experiences. The key issue being that all learners should have equivalent (not neccessarily identical) experiences – for example would a text transcript of an interactive video provide parity of experience for a blind user? Probably not, but there may be a combination of alternative experiences that would.

The accessibility of any learning resource is relative to the user at the point of delivery. All resources are accessible to someone but some are more inclusive than others and some can be made more accessible at the point of delivery by effective staff intervention. Materials used in a distance learning context or produced for use by others in a different context (e.g. a repository) need a far higher degree of implicit accessibility than those used in a known class context where human intervention can moderate the learning experience.

KEY CONSIDERATIONS

Some of the key considerations when designing and delivering inclusive e-learning include:

- Adapting the learning experience for inclusion may be more effective and sustainable than adapting the resource.
- Good practice is typically about variety of approach, flexibility, adaptability, innovation and responsiveness to learners.
- By considering the benefits of different types of experience to different learners, reflecting on accessibility should encourage diversity of learning experiences rather than monotonous convergence to 'lowest common denominators of accessibility'.
- The guiding questions should be "who will this benefit?" and "what can I do for those who will be excluded by this?" If a resource adds value to some of your learners and excludes none of your learners then there is no reason not to use it. You do however need to cultivate the awareness of what you might do if future learner cohorts included some who were unable to access that resource.

You do not have to understand everything about accessibility in order to start making a difference, and don't be afraid to ask for help. If in doubt, talk to the learners – if they are happy then you are probably succeeding.

USEFUL RESOURCES

Accessibility Essentials – guides to working with electronic documents and PowerPoint in a more inclusive way: *http://www.techdis.ac.uk/accessibilityessentials*

TechDis helpdesk *http://www.techdis.ac.uk/index.php?p=7*

Guide to Creation of Inclusive e-Learning materials: *http://www.techdis.ac.uk/index.php?p=9_7*

Staff Packs – self-supporting staff development modules *http://www.techdis.ac.uk/staffpacks*

Teachability - a framework for creating a more accessible curriculum: *http://www.teachability.strath.ac.uk*

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JORUM FOR THE BIOSCIENTIST

Jorum is a JISC-funded, free, online service for UK Higher and Further Education institutions, supporting the sharing, reuse and repurposing of learning and teaching resources. The service, which is still in development, is run by staff based at the MIMAS (*http://www.mimas.ac.uk*) and EDINA (*http://edina.ac.uk*) Data Centres, at the Universities of Manchester and Edinburgh.

The Jorum repository offers a searchable, online library of digital learning and teaching resources for UK teaching and support staff. It uses a system called intraLibrary, procured from Intrallect Ltd (*http://www.intrallect.com*).

There are two elements to Jorum: a Contributor Service and a User Service. Jorum Contributor allows colleges and universities to upload learning and teaching resources, while Jorum User provides access to the resources for institutions that have signed up. The Contributor Service was launched in November 2005 and the User Service was made available in January 2006. A number of the resources found in Jorum will be of interest to bioscientists.

CONTRIBUTING TO JORUM

Jorum Contributor allows institutions and project teams to share learning and teaching resources with colleagues in the UK. Jorum hosts resources that have been publicly funded as well as resources which have been developed by institutions.

Over 40 UK institutions have signed up to deposit electronic resources so far. Many funded projects have approached Jorum hoping to contribute resources, some projects wished to help colleagues and peers across the UK by providing content which saves staff time. Other projects have a requirement to disseminate outputs at the end of a funding period.

Jorum would welcome more contributions of resources covering bioscience disciplines. Potential contributors should visit the Jorum web site *(http://www.jorum.ac.uk)* to find out about the process involved and the help we offer. Jorum is beginning to work with a number of Higher Education Academy Subject Centres. A number of CETL (Centres for Excellence in Teaching and Learning) projects have also shown interest in contributing resources.

A document entitled 'Contributing to Jorum' on the Jorum web site deals with common concerns raised by potential contributors. One common staff concern is they feel their resources are very specialised and so will not be of any use to anyone else. Jorum reasons that users not only benefit from accessing resources as they are, but they can then develop resources further by modifying them to their own needs. This enriches their students' learning experience.

JORUM USER

Jorum User provides access to the shared repository of resources. Institutions can register for this for free through the JISC Collections web site *(http://www.jisc-collections.ac.uk)*. Teaching and support staff in institutions who subscribe to this service can find, preview, download, reuse and repurpose resources for use with learners in their institution. Currently students cannot access the service.

Jorum contains both learning and teaching resources, which cover a range of subject areas. Learning resources in Jorum range from single assets (documents, animations, diagrams) to comprehensive learning objects (interactive units and content packages). There are some teaching resources in Jorum which will support staff in delivering these resources. The Jorum team have worked to ensure that the resources are compliant with e-learning standards and are therefore interoperable across a range of platforms.

Over 250 institutions have currently signed up to access the resources, through Athens authentication. There are currently over 1800 resources with more being added daily. It will take time to develop a collection of resources covering all subject areas, but already many teaching and support staff have found resources to be of great benefit.

BIOSCIENCE RESOURCES

A number of learning resources relevant to bioscientists are already on offer through Jorum, here are a few examples covering a variety of subjects:

- *Green Plants*. This interactive learning resource was produced in Macromedia Flash, and is classified under 'Plant Science'. It looks at different aspects of green plants, covering four sections: plant adaptations; plant nutrition; transport and water relations; plant hormones and minerals;
- *Industrialisation* of Agriculture. This learning resource engages learners over a 20 minute period, using charts, diagrams and questions. The unit introduces the agricultural system of input, production, output and impact; and
- *Heart Anatomy*. A number of resources cover human anatomy such as this resource, which is a gross anatomy of the normal human heart. Similar objects include the lungs, blood vessels, the respiratory system and bones.

While users of Jorum can take advantage of existing resources, we would welcome contributions of bioscience resources to broaden the collection.

JORUM SUPPORT

The Jorum web site provides news, information, guidance, training materials, publications and help (support@jorum.ac.uk). There is also a Jorum mailing list which alerts subscribers to any news, events and newly added resources.

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SUPPORTING MATHEMATICS LEARNING

There are relatively few 'free' e-resources to support mathematics learning at an undergraduate level, and fewer aimed primarily at bioscience students. Nevertheless, the following represent examples of resources readers may find useful and to which they may wish to direct their students.

Maths and Computers for Biologists
(http://www-micro.msb.le.ac.uk/1010/index.html)
Developed by Alan Cann, author of *Maths from Scratch for Biologists*, this site provides an introduction to numeracy and statistics. Topics within the former include units and conversions, molarities and dilutions, areas and volumes. The latter section provides an introduction to descriptive and inferential statistics.

Mathagony Aunt
(http://www.mathagonyaunt.co.uk/mathFrameset.html)
Mathagony Aunt evolved from a regular column of the same name published in the *Times Education Supplement* (TES), in which the highly experienced mathematician Wendy Fortescue-Hubbard answered readers' queries about maths. The web site provides a number of resources, including PowerPoint presentations and interactive Excel spreadsheets which may be used to explain some mathematical concepts, e.g. standard form.

NRICH
(*http://nrich.maths.org/public/index.php*)
NRICH represents part of the Millennium Mathematics Project (*http://mmp.maths.org/*), a maths education initiative for 5- to 19-year olds and the general public, launched in 1999 and based at the University of Cambridge. The web site offers a large and expanding resource base, which covers a wide range of maths topics and offers students challenging activities (problems and games) which provide them with opportunities to develop their mathematics knowledge and skills. Activities are graded according to educational stage and level of the challenge presented. Resources associated with specific maths topics may be found by using the site's 'Maths Finder' page.

Mathletics
Mathletics is an extensive suite of objective maths tests developed by Martin Greenhow and his team at Brunel University, using QuestionMark Perception. This computer -aided assessment system, designed for students studying maths from GCSE to undergraduate level, can be used to deliver diagnostic, formative or summative assessments. For further information and details on availability contact Martin Greenhow *(martin.greehow@brunel.ac.uk).*

mathcentre
(http://www.mathcentre.ac.uk/)
mathcentre has been established by the Universities of Loughborough, Leeds and Coventry, in collaboration with the Educational Broadcasting Services Trust, and the HE Academy's Subject Centres. The centre offers students and their tutors a range of mathematics support materials, free of charge; these include reference guides, practice and revision materials, video tutorials, workbooks and online practice exercises on many mathematics topics, including: Algebra, Arithmetic, Complex Numbers, Differentiation, Drug dose calculations, Finance, Functions and Graphs, Geometry, Graphs for health sciences, Integration, Matrices, Mechanics, Numeracy Skills, Sequences & Series, Statistics, Trigonometry and Vectors.

mathtutor *(http://www.mathtutor.ac.uk/)*
mathtutor represents a set of digital resources that have been designed to help students with their basic mathematics as they make the transition from secondary level education to university. It provides learners with access to more than eighty maths topics and supports their learning through the provision of video tutorials, diagnostic tests, summary text and exercises. **math**tutor may be accessed online at *http://www.mathtutor.ac.uk* or via links on the mathcentre web site at *http://www.mathcentre.ac.uk/students.php* Alternatively, the seven DVDs of content may be purchased, individually or as a set, from the Educational Broadcasting Services Trust via *http://www.mathtutor.ac.uk/getdisks.shtml*

biomathtutor
During the past year a team of academics has been working in collaboration with the Educational Broadcasting Services Trust on a project funded by HEFCE's National Teaching Fellowship Scheme. The primary aim of this project has been to develop **biomath**tutor; a pilot DVD-ROM of video-led multimedia e-learning resources to support mathematics learning in the biosciences. Their strategy has been to adopt the technologies used in the production of **math**tutor, but to apply a contextual, problem-solving learning model.
The Higher Education Academy, through one of its e-Learning Research Grants for 2006, is funding a 12-month project which aims to assess the impact of blending this multimedia e-learning resource with traditional teaching methods to support mathematics learning within the life sciences. For further information contact Vicki Tariq *(vtariq@uclan.ac.uk).*

Intute *(www.intute.ac.uk/)*
Intute, provided by a network of UK universities and partners, offers a free online service to help you keep up to date with the best Internet resources available. *Intute's* subject specialists select, evaluate and provide descriptions of the web sites added to its database, which currently contains over 113,000 entries. Entering 'maths' into the site's search engine (located on the home page) currently returns over 200 records of maths-related items. *Intute* is well worth a visit.

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10

VIRTUAL PRACTICALS

Frustrated by old lab equipment, in short supply, and shared amongst large groups of students? Questioning traditional wet lab pedagogies? Does it make sense to ask students to write up variable, group-generated results?

Six years ago these were some of the experiences of one of our lecturers in the Biosciences. . . and it spurred us to consider alternatives. . . replacing appropriate wet labs with an online, web-based, virtual lab, hosting a series of simulations of traditional, tried and tested practical experiments. Despite some reservations, both lecturer and students are very pleased with the results.

YOU CAN'T HAVE VIRTUAL 'WET'. . . CAN YOU?

There is often an antipathy to the use of computers to simulate traditional experiments, especially the wet lab. However, the traditional hands-on practical does not really exist in many university settings. Reasons for this include large class sizes, and the consequent reduced staff : student ratio, but also limited access to equipment – particularly noticeable in older degree programmes where 'Heath Robinson' approaches to keeping equipment serviceable can only be applied for so long. Faced with these challenges we asked ourselves exactly what is so important about the wet lab experience and can it really not be simulated on a computer? Discussions with colleagues identified a number of valued features:

- Personal responsibility – ownership of the process and its results;
- Reactive environment – real life does not involve clicking the 'next' button;
- Repeatability;
- Datasets that are extensive, representative and unique; and
- Fallibility – experiments can appear to go OK even when they do not.

Generally, it was felt that while computer simulations may have offered an (often limited) interactive environment and were highly repeatable, the other important features were lacking or non-existent. Our objective was therefore to design new learning environments based on the best of the old wet labs combined with the functionality offered by emerging web technologies. We started by developing simulated experiments to explore the effect of heavy metal sub-lethal toxicity on *Gammarus duebeni*. Three experiments to test respiration were devised, involving measuring respiration rate by counting pleopod beats, efficiency of respiration while swimming in a current and quantity of oxygen consumed in a controlled environment.

A fourth experiment, based on the oxygen consumption experiment, allowed the students to test previously poisoned *Gammarus* and estimate their prior exposure using the earlier data gathered under controlled conditions.

In each experimental situation the students were required to engage with the environment and take responsibility for the experiment running successfully. Each simulation was designed so that it was possible for the student to make mistakes and generate erroneous data or for the experiment to fail (even catastrophically so they would have to begin again). Although we took advantage of the opportunity to accelerate some of the natural processes, students were not excused from the laborious experience of manually collecting repetitive data. Unlike some computer-based materials the data were not presented as a *fait accompli*, but had to be gathered by reading scales, counting events (manually recording these in lab books) and printing off simulated pen-chart recordings. All the data generated were calculated in real time with random variance unique to each student and each run, and modelled to be within the realms of expectation if these were in fact wet labs.

KEEPING A LAB BOOK OF THE VIRTUAL WORLD

As with traditional wet labs, the students were given a lab manual at the start of the practical, had to keep a lab book and had to write up the experiment, complete with an analysis of the results, the relationship between the experiments and a discussion. While the virtual laboratory had a built-in set of instructions, a glossary and a maths tutorial to assist with some of the calculations necessary to conduct the experiments, students were also expected to read around the literature.

The assessment of the practicals within this class (ca. 120 students) has always taken a long time (ca. 30 hr). There has been discussion about adapting the virtual practical to be either partially or totally computer marked. Though this is technically possible, it was decided that it was beneficial and more meaningful for the students to continue handing in a written report. The time required for marking has been shortened by about 15%, largely due to a significant reduction in correcting calculations brought about by incorrect datasets and errors in data collection, but there has a been a significant increase in the depth and complexity of the 'Discussion' section written by the students. The students' hand-ins show a far higher level of understanding of the topic than when using the previous wet lab across the whole class, but especially in the weaker students who previously would have become bogged down with nonsensical conclusions based on incorrect datasets or simply failed to submit the report.

Our experience of using a virtual practical in place of this wet lab has shown us that the traditional values do not have to be sacrificed when using computers and on occasion can actually raise the quality of the intended learning experience.

The Virtual Laboratory was the outcome of a project during 2001 involving the Department of Zoology and the Learning Technology Unit, both University of Aberdeen.

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'CLICKERS' IN BIOLOGY LECTURES

The University of Edinburgh has just completed the first year of a project to introduce 'clickers' into lectures. In the School of Biological Sciences, this was trialled in a large, first-year biology class (450 students). The year has been a huge learning experience and this article aims to share some of that experience.

'Clickers' are small, portable keypads that allow students to vote in a lecture. For example, the lecturer can pose a multiple choice question and the student can use their clicker to select their chosen answer. Software running on the lecturer's laptop collects and counts up the votes. The summarised votes of the entire class can then be displayed as a chart.

We opted for a basic Infra Red system, on the grounds of cost. This relies on a clear line of sight between the clicker and a receiver, a number of which need to be installed in the theatre. Systems based on radio frequency are also available. These pick up a greater percentage of the votes, but it would have cost three times as much as the IR system we chose (although the difference has reduced since the start of the trial). However, the IR system was adequate for the purpose of our project.

In our project, we loaned a clicker to each student for the duration of the course. It was the intention that students would use their clicker at least once in every lecture, and in some tutorials. During the trial, we spoke to a number of students via focus groups.

All of the students we questioned (in biology and in other subjects) were very enthusiastic about the use. They felt:

- It broke up the lecture, allowing them to refocus after the question (with a higher level of attention);
- It tested them on whether they understood the material immediately, rather than waiting until 2 weeks prior to the exam to realise they had missed the point;
- They could compare their progress with their peers; and
- It gave the lecturer an idea of how the class as a whole were coping with the material.

We compared biology students in a parallel trial with a first-year physics course (ca. 250 students) that was also using clickers for the first time The physics course, has for a number of years, embedded a 'low tech' version of voting during their lectures. Students used a show of coloured cards to answer multiple choice questions presented in the lecture. The physics students preferred the clickers over the coloured cards due to the greater flexibility in the number of possible answers and the anonymous nature of voting.

Although the biology students were very enthusiastic, the response rate/participation in lectures was not as high as in physics. Having ruled out various technical considerations, our opinion is that we allowed biology students to perceive that our use of clickers was experimental. In contrast, based on their previous experience, physics had already the confidence to present clickers as a core activity in their course. In addition, physics had a head start in having already developed a bank of questions that probed students' misconceptions.

It became clear that in biology too the best questions do highlight to students their misconceptions. In this respect we felt that there was no pedagogical distinction with physics, nor should there be. A biology course that did not impart fundamental concepts would be a poor one indeed. However, it is no trivial task to analyse afresh what are the core concepts in a biology course and, more difficult still, the misconceptions students have – although exam answers are a good start! In fact, designing the questions is a very reflective process and has made us step back and take a high-level look at the course – the concepts we are teaching and the way those concepts are delivered. It is ironic, perhaps, that technology can sometimes advantageously drive change and influence pedagogy!

Based partly on the experiences in this trial, the College of Science and Engineering has decided to purchase more clickers to be used more widely in the college. For our first-year biology course, we will be building on the experience from last year – including looking at consistency of question types/timings/frequencies, introducing the clickers more formally (with a stronger emphasis on the technique being a core teaching tool to encourage self-assessment by the students of their learning) and using them more innovatively in workshops for group work.

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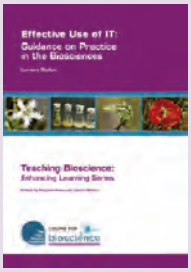
NEW GUIDE



Effective Use of IT: Guidance on Practices in the Bioscience by Lorraine Stefani.

Order a free hardcopy (heabioscience@leeds.ac.uk) or download a pdf version from *http://www.bioscience.heacademy.ac.uk/publications/tbel/elearn.htm*

E-LEARNING EVENT

Effective E-Learning: IT's about pedagogy as well as technology

Wednesday 13th December 2006, Manchester Metropolitan University.

Further details at: *http://www.bioscience.heacademy.ac.uk/events/elearn06.htm*

SOCIAL BOOKMARKING

One increasingly popular way for students to organise, find and share online resources is through the use of social bookmarking tools. Social bookmarking sites allow users to organise their content by assigning them 'tags'. 'Tagging' can be as easy as visiting a quality web page, clicking a button on your toolbar and then manually typing in a keyword or selecting one from a pull down menu. The result is a type of online taxonomy or 'folksonomy', which enables additional use of the data by grouping and analysing the results and summarising useful information. Users can then register for RSS feeds of the topics they are interested, or of the links a particular user tags. The majority of bookmark lists are publicly accessible (though many offer privacy options), and allow you to search and view links by category, specific tags or randomly. Some sites will even periodically notify users when urls are broken. Social bookmarking services are particularly beneficial for people who work from different computers and need to always have their bookmarks readily available.

As a tutor, social bookmarks can provide a useful way to pass information among teachers and to learners, for example in the form of a reading list or by encouraging students to subscribe to relevant RSS feeds. They can also encourage sharing of information, for example by asking your students to tag noteworthy urls. By deciding in advance on a tag for a specific event or course, a shared repository can quite easily be created. This repository may then be used and built on in the next academic year by new students. Commenting on and rating bookmarked urls can also be a useful way to help decision-making when creating bibliographies and enable critical thinking. Use of a bookmarking site may also help with maintenance issues (tutors no longer have to email all their students when a noteworthy new paper is out). I have used bookmarking tools on numerous occasions for workshops and events. Students only need to take away the url for the event bookmarks and they can use (or add to) the growing list of resources when ever they chose.

There are an increasing number of bookmarking tools geared to the education sector. Some of the most worthy of note are:

CiteULike *(http://www.citeulike.org)* is a free service that allows academics and students to tag the academic papers they are reading, it then automatically extracts the citation details. Any paper or web site can be added to an individual's library but for a url to be publicised on 'Everyone's Library List' it has to come from the list of supported journals. This enables the focus to remain academic. Other useful facilities offered include the option to build your library in to your bibliography by exporting it to BibTeX or Endnote, and the opportunity to join a bioscience-specific group (collections of users) to pick up 'hot links'.

It remains difficult to discuss social bookmarking tools without mentioning del.icio.us *(http://del.icio.us/)*, probably the most popular tool available with over 60,000 user accounts. Developed in late 2003 by Joshua Schachter, it was taken over by Yahoo in December 2005. It is a more general bookmarking tool, but has been used by academics and lay-persons alike in a number of interesting ways. External developers have used del.icio.us as a test bed and there are some very useful extensions available, for example it is possible to synchronise your bookmarks between the browsers on your work machine, home machine and laptop and your del.icio.us account.

Unlike the previous two tools, Connotea *(http://www.connotea.org/)* was established by an organisation rather than an individual: Nature Publishing Group's New Technology department project, led by Ben Lund. It was seen initially as an experimental, scientific social bookmarking facility like del.icio.us and has a target audience of scientists, researchers and clinicians. The site supports importing and exporting with a number of desktop reference management systems (using a common citation format called RIS) and from Firefox browsers. Connotea is also equipped to function as a citation manager itself and currently supports retrieval of metadata elements in RIS from a number of sites including PubMed, HubMed, Amazon.com, Nature.com, and D-Lib Magazine. Papers can also be added by providing the Digital Object Identifier (DOI) to save time.

For an interesting introduction to social bookmarking tools from the creators of Connotea have a look at Social Bookmarking Tools (I) A General Review *(http://www.dlib.org//dlib/april05/hammond/04hammond.html).*

The Siphs site (*http://www.siphs.com/*) was created by Arpan Jhaveri and Tom Sharpton in response to their frustration at finding relevant scientific information and contacts on the Web. It aims to "expedite scientific discovery by facilitating information sharing and open dialogue within the biological and biomedical sciences community." A social bookmarking tool is just one instrument in its lifesciences community package, others include a discussion board and contacts list.

Furl *(http://www.furl.net)* allows you to create what it calls a 'personal Web' by saving a copy of every web page you tag, each user has 5 GB of storage. This means that you can search in turn the full text of your archived items. By combining search terms you can carry out advanced searches of quality resources, which will provide some very useful results. Furl also has a facility to allow teachers and librarians to create pre-selected and tagged lists of resources for students to browse.

Social bookmarking creates communities of like-minded users by the simple act of tagging a url. The biggest advantage is sharing the insight of others, as Isaac Newton famously once said "If I have seen further it is by standing on ye shoulders of Giants." Anyone for a leg up?

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